PEACE/WILLISTON
FISH & WILDLIFE
COMPENSATION
PROGRAM

BC hydro

BRITISH
COLUMBIA

Donna Creek Forestry/Biodiversity Project:

Phase 1 – Early Seral Stage (1991 – 1996) Summary Report

E. T. Manning and P. Chytyk
March 2004

PWFWCP Report No. 289

105-02339/

The Peace/Williston Fish & Wildlife Compensation Program is a cooperative venture of BC Hydro and the provincial fish and wildlife management agencies, supported by funding from BC Hydro. The Program was established to enhance and protect fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon dams on the Peace River, and the subsequent creation of the Williston and Dinosaur Reservoirs.

Peace/Williston Fish and Wildlife Compensation Program, 1011 Fourth Ave. 3rd Floor, Prince George B.C. V2L 3H9

Website: *www.bchydro.com/pwcp/*

This report has been approved by the Peace/Williston Fish and Wildlife Compensation Program Wildlife Technical Committee.

Citation: Manning, E.T. and P. Chytyk. 2004. Donna Creek Forestry/Biodiversity Project: Phase 1 – Early Seral Stage (1991 – 1996) Summary Report. Peace/Williston Fish and Wildlife Compensation Program Report No. 289. 21 pp.

Author(s): E. Todd Manning[1] and Paul Chytyk[1]
Address(es): [1] Manning, Cooper and Associates, 5148 William Head Rd., Victoria, BC V9C 4H5.

EXECUTIVE SUMMARY

The Peace/Williston Fish and Wildlife Compensation Program (PWFWCP) is a cooperative program between BC Hydro and provincial fish and wildlife agencies, which is funded by BC Hydro. The program was established to conserve and enhance fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon Dams, which flooded the Peace River watershed, creating the Williston and Dinosaur Reservoirs.

The Donna Creek Forestry/Biodiversity Project was a cooperative initiative between the PWFWCP and Slocan Forest Products Ltd. (formerly Fletcher Challenge Canada Ltd.) from 1991-1996. The goal of the project was to develop and evaluate whether alternative stand-level harvesting practices that maintain forest structural attributes would benefit forest songbirds, woodpeckers and mammalian (i.e., mustelid) cavity-users.

The Donna Creek project was designed to determine whether creating 3 m high stubs and retaining small tree islands of residual forest in clearcuts would benefit cavity-users and other wildlife species. To test the effectiveness of stubs and tree islands as wildlife habitat, a study design was developed that compared four different experimental treatments within a single cutblock:

1) **clearcut area** – no stubs or tree islands present;
2) **stub** – stubs relatively evenly dispersed throughout a clearcut;
3) **tree island** – small residual forest patches (mean 0.25 ha in size), evenly dispersed throughout a clearcut, which were fringed by a perimeter of stubs;
4) **stub-and-tree island** – tree islands fringed with a perimeter of stubs that were distributed throughout a clearcut, with evenly dispersed stubs retained in-between the tree islands.

Some of the project's key findings were:

- stubs and tree islands increased the diversity of bird species detected compared to clearcuts due to the additional habitat elements that stubs and tree islands provided.
- stubs that are retained should be as large as possible, and preferably >27 cm in diameter at breast height. All stubs used for nest cavities contained heartrot (i.e., their wood condition was rated as soft or very soft). Spruce and subalpine fir should be selected as stubs over lodgepole pine as they showed higher preferential use by woodpeckers.

- total bird densities, (i.e., combined singing males and other detections) were significantly lower in all experimental treatment units compared to old-growth forest controls.
- tree islands should at least be larger than 0.4 ha to provide habitat conditions suitable for a greater variety of forest bird species.
- larger tree islands (≥2 ha) and higher densities of stubs (>15 stubs/ha) appear to provide greater habitat benefits to a greater number of bird species than smaller tree islands and lower stub densities.
- furbearer studies were generally inconclusive for determining any habitat preferences between experimental units and control areas, mostly due to the large territorial sizes and the small number of individual furbearers found in the study area.

The data collected to date (1991-1996) in the Donna Creek project should be considered a valuable snapshot and initial step only, but not a complete assessment of the effects that stubs and tree islands may have on wildlife species habitat use. In order to determine long-term trends and the efficacy of various forest harvesting treatments on wildlife habitat use, a long-term survey and monitoring program conducted as part of an adaptive management strategy is suggested.

ACKNOWLEDGEMENTS

Funding for this report was provided by the Peace/Williston Fish and Wildlife Compensation Program. The authors would like to thank Mari Wood and Fraser Corbould for reviewing and providing comments on a previous draft of this report.

TABLE OF CONTENTS

EXECUTIVE SUMMARY i
ACKNOWLEDGEMENTS iii
TABLE OF CONTENTS iv
1.0 INTRODUCTION 1
2.0 STUDY AREA 2
3.0 METHODS 4
3.1 Stubs, Tree Islands and Other Habitat Features 4
3.2 Cavity Nesting Birds 6
3.3 Songbirds 7
3.4 Furbearers 7
4.0 RESULTS 9
4.1 Stubs, Tree Islands and Other Habitat Features 9
4.2 Cavity Nesting Birds 10
4.3 Songbirds 12
4.4 Furbearers 13
5.0 SUMMARY 15
5.1 Stubs, Tree Islands and Other Habitat Features 15
5.2 Cavity Nesting Birds 15
5.3 Songbirds 15
5.4 Furbearers 16
6.0 CONCLUSIONS AND RECOMMENDATIONS 17
6.1 Stubs, Tree Islands and Other Habitat Features 17
6.2 Cavity Nesting Birds 17
6.3 Songbirds 18
6.4 Furbearers 19
REFERENCES 20

LIST OF TABLES

Table 1: Summary of cavity nests found in habitat features within experimental units and in control areas at the Donna Creek study area (1995-1996). Number of active nest cavities followed by number of nest trees in parentheses. Data from Gyug (2002). 11
Table 2: Statistical differences between densities of 21 bird species found in experimental units and control areas in the Donna Creek study area (1995-1996). 13

LIST OF FIGURES

Figure 1: Location of the Donna Creek study area in the Williston Reservoir watershed in north-central British Columbia. 2
Figure 2: Locations and arrangement of experimental cutblocks (Blocks 5516, 5546 and 5547), clearcut control cutblocks (Blocks 5510, 5549 and 5550) and old-growth control areas (OG1, OG2 and OG3) within the Donna Creek study area. 5

1.0 INTRODUCTION

The Peace/Williston Fish and Wildlife Compensation Program (PWFWCP) is a cooperative program between BC Hydro and provincial fish and wildlife agencies, which is funded by BC Hydro. The program was established to conserve and enhance fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon Dams, which flooded the Peace River watershed, creating the Williston and Dinosaur Reservoirs.

The Donna Creek Forestry/Biodiversity Project was a cooperative initiative between the PWFWCP and Slocan Forest Products Ltd. (formerly Fletcher Challenge Canada Ltd.) started in 1991. The goal of the project was to develop and evaluate whether alternative stand-level harvesting practices that maintain forest structural attributes would benefit forest songbirds, woodpeckers and mammalian (i.e., mustelid) cavity-users.

BC Workers' Compensation Board (WCB) regulations at the time[1] prohibited the maintenance of any standing dead or diseased trees that were >3 m in height on worksites (i.e., harvest cutblocks, Backhouse 1993). Consequently, the project was designed to determine whether creating 3 m high cut stumps (stubs) and retaining small tree islands of residual forest in clearcuts would benefit cavity-users and other wildlife species.

The purpose of this report is to provide a synopsis of all activities conducted between 1991 and 1996 (Phase I, "early seral stage") thus providing the methods, results and key findings for all early seral stage activities in one concise document.

[1] Current WCB regulations (sec. 26) permit the retention of standing dead trees in forestry operations provided they do not pose a hazard to workers or the work area. See the Wildlife Tree Committee of BC website (www.for.gov.bc.ca/hfp/wlt/) for more information on dangerous tree assessment.

2.0 STUDY AREA

The Donna Creek study area is located approximately 80 km northwest of Mackenzie and 240 km north of Prince George at the south end of the Wolverine Range of the Omineca Mountains in north-central British Columbia (Figure 1). A detailed description of the study area can be found in Dawson et al. (1992) and Gyug and Corbould (2002).

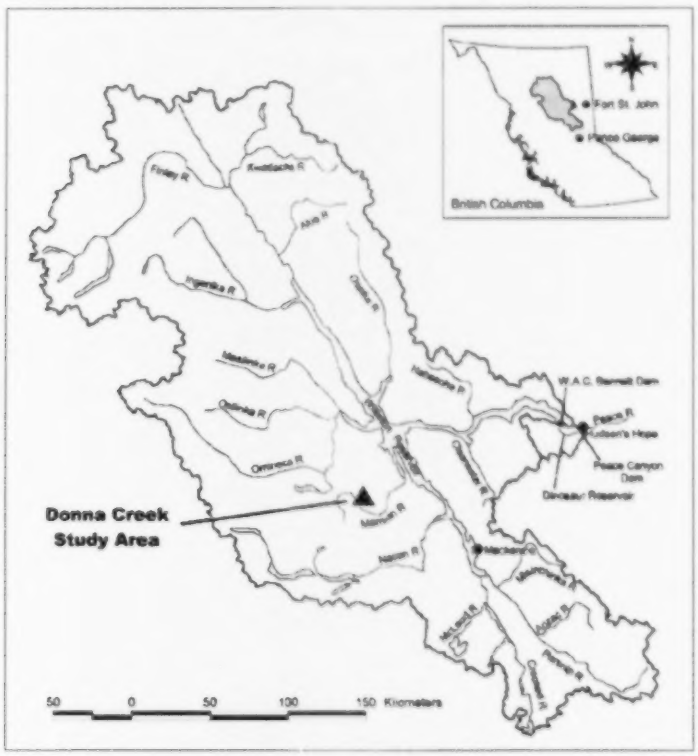

Figure 1: Location of the Donna Creek study area in the Williston Reservoir watershed in north-central British Columbia.

The study area is located in the Manson Plateau ecosection of the Omineca Mountains ecoregion of the Sub-Boreal Interior ecoprovince (Demarchi 1995). Study plots were located within a 13 km span along the north side of Solomon Creek in the Moist Very Cold Engelmann Spruce-Subalpine Fir (ESSFmv3) biogeoclimatic subzone variant. The ESSFmv3 is characterized by relatively open canopies of Engelmann spruce (*Picea engelmannii*) and subalpine fir (*Abies lasiocarpa*) that are dominant climax tree species with

lodgepole pine (*Pinus contorta*) as a widespread seral tree species (MacKinnon et al. 1990). Small amounts of mature black cottonwood (*Populus balsamifera trichocarpa*) were also present in the study area.

Study blocks varied in elevation between 980-1,330 m and were located on southwest facing aspects (Gyug and Corbould 2002). Slopes were variable from relatively flat, to moderately steep undulating slopes. Although forest types were generally similar, the uneven topography created a mixture of soil moisture regimes that ranged from well-drained slopes, to areas with standing water that affected vegetation communities within the treatment units and control areas.

3.0 METHODS

3.1 Stubs, Tree Islands and Other Habitat Features

The study design was a randomized block 2x2 Analysis of Variance (ANOVA) that tested the efficacy of the experimental treatments (Gyug 1997). The first factor of the ANOVA was the retention of stubs (3 m high stumps) at two prescribed levels: 1) absence, and 2) densities of 5-10 stubs/ha (Dawson et al. 1992). The second factor was the retention of mature tree islands at two prescribed levels: 1) absence, and 2) one tree island (0.25 ha in size) per 8 ha of harvested area. A complete statistical explanation of the study design can be found in Gyug (1997).

Three experimental treatment cutblocks were compared to three clearcut controls and three old-growth forest controls. Each of the three experimental cutblocks (average size 107.6 ha; Gyug and Corbould 2002) was divided into four separate within-block treatment units: clearcut area, stub, tree island, and stub-and-tree island (Dawson et al. 1992) (Figure 2). These are described below:

Clearcut Area:	Traditional clearcut area, no stubs or tree islands present.
Stub:	Stubs dispersed relatively evenly across the harvested area.
Tree Island:	Small residual forest patches that were evenly distributed throughout the harvested area. Each island was surrounded by a fringe of stubs around its perimeter.
Stub-and-Tree Island:	Residual forest patches (tree islands) surrounded by stubs around their perimeters, with evenly dispersed stubs retained in-between the tree islands.

The average size of the experimental treatment cutblocks was 26.9 ha (Gyug and Corbould 2002). Dispersed stubs were created by fellerbunchers, and their densities averaged 6.3 stubs/ha (range 4.7-9.5 stubs/ha) across all stub-retained experimental units. The average size of the tree islands was 0.26 ha (range 0.18-0.40 ha) and occupied on average 3.5% of the harvested area[2]. Tree islands were fringed with perimeter stubs that averaged 45.3 stubs/island (142 stubs/ha). Experimental units were harvested in 1991 and 1992 and were

[2] Average size calculated for 21 of 22 tree islands and excludes a single large tree island (1.4 ha) that was created due to slope stability concerns.

planted between 1993-1995 with spruce and/or lodgepole pine seedlings that varied in density and mixture.

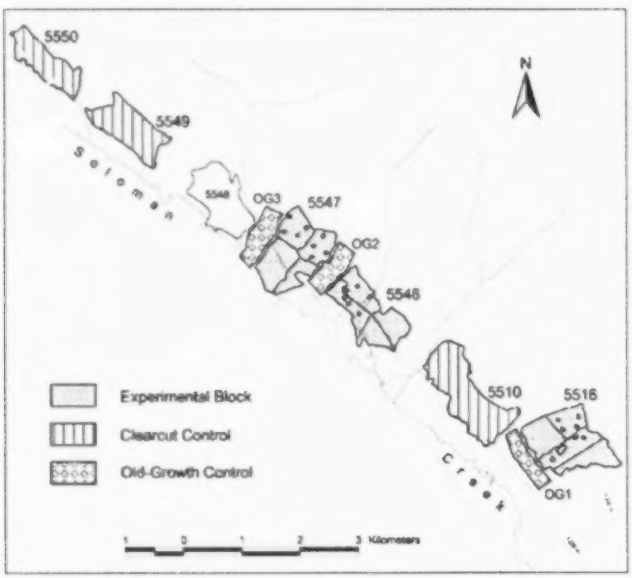

Figure 2: Locations and arrangement of experimental cutblocks (Blocks 5516, 5546 and 5547), clearcut control cutblocks (Blocks 5510, 5549 and 5550) and old-growth control areas (OG1, OG2 and OG3) within the Donna Creek study area.

Clearcut control cutblocks averaged 84.9 ha in size and were harvested between 1987-1992 and planted between 1989-94 with spruce and/or lodgepole pine seedlings that varied in density and mixture (Gyug and Corbould 2002). Old-growth controls were not measured for size as they were located in contiguous forest. Old-growth controls were thought to be representative of the surrounding forest and were relatively open canopied (average range 17-23%) stands of subalpine fir, spruce and lodgepole pine situated on variable slopes that ranged from 4-55%.

Vegetation and physical data were collected at each of the songbird point-count stations as habitat samples for each of the experimental units. Data collected within a 11.3 m radius plot (0.04 ha) of the point count centre included: percent cover of main canopy and subcanopy trees (>10 m high), tall shrubs (2.0-10.0 m high), low shrubs (<2.0 m high), surface substrate, and moisture regimes; abundance and characteristics of wildlife trees; and number of stumps and upturned root balls. Data collected within a 50 m radius of the point count centre

included: slope (%); aspect (°); mesoslope position; number of stubs within 25 m and 50 m radii; and percent cover of moisture regimes. Also, coarse woody debris (pieces >7.5 cm diameter) was measured along 2 right-angle 24 m transects radiating from the plot centre. See Gyug and Corbould (2002) for detailed descriptions of methods.

In 1996, 20% of all stubs in the stub and stub-and-island treatment areas were systematically sampled (every 5th stub encountered) and assessed. For each stub the following data were collected: species; DBH; decay stage; percent bark remaining; root condition; dominant heartwood and sapwood condition; any tree defects; any woodpecker feeding sign; nest cavity characteristics; and any birds or animals observed and their behaviour. See Gyug and Corbould (2002) for detailed descriptions of methods.

In 1992, all trees and snags were tagged and identified in 4 tree islands in Block 5547. In 1996, these 4 tree islands were revisited and the tag numbers of all standing trees and snags were recorded, as well as all tag numbers of trees or snags that had fallen, where possible. Stems that were tagged in 1992 and subsequently not relocated in 1996 were presumed to have fallen and comprised calculated retention rates. Only trees and snags ≥17.5 cm DBH were used to calculate stem densities in tree islands to make data comparable top pre-logging forest data. See Gyug and Corbould (2002) for detailed descriptions of methods.

3.2 Cavity Nesting Birds

In 1995, surveys for cavity nesting birds were conducted on an ad hoc basis between 22 May and 26 June (Gyug 2002). Cavity nests were searched for opportunistically while conducting other songbird surveys or during periodic intensive search periods when adults were followed to nest cavities or when nest cavities were discovered by listening for juvenile begging calls. See Joy and van den Driessche (1998) for a detailed descriptions of these methods.

In 1996, surveys for cavity-nesting birds were more systematic and were conducted between 29 May and 4 July (Gyug 2002). Surveys in 1996 included systematic searches (surveyors searched for cavity nests along parallel transects that were spaced ≤ 50 m apart from one another); call playback searches (taped calls/drumming of various woodpecker species were broadcast along transects and responding adults were followed to nest cavities); intensive local searches (up to 3 hours were spent searching for cavity nests in localized areas where cavity nesting birds had been previously observed); stub assessments (cavities that were discovered during stub assessment surveys were resurveyed and monitored to determine

occupancy); and incidental sightings (chance observations of cavity nesting birds were recorded and follow-up surveys were conducted). See van den Driessche and Joy (1998) for detailed descriptions of methods.

In 1995, active cavity nests were monitored during the survey period on an ad hoc basis to determine fledgling success. In 1996, active nests were monitored at least once every 4 days by viewing inside cavities with a dental mirror and flashlight to determine egg and/or nestling numbers, and later, visually monitored for fledglings. All active cavity nests that were found in 1995 and 1996 were described and measured at three levels: nest-tree surroundings (within 11.3 m and 50 m radius plots centred on the nest tree), nest-tree structure (i.e., tree species, wildlife tree class) and nest cavity location (i.e., height above ground, aspect). See van den Driessche and Joy (1998) for detailed descriptions of these methods.

3.3 Songbirds

Preliminary breeding bird surveys using encounter transects were initiated in 1993. See Gyug and Summers (1995) for detailed descriptions of methods. However, encounter transects were subsequently replaced with point count surveys in 1995 and 1996 to provide a stronger survey design (van den Driessche and Joy 1998). In total, 149 permanent 50 m radius point count stations were established throughout the different treatment units and controls in the study area. Point counts were spaced a minimum of 115 m apart from one another to prevent sampling overlap. Each point count was surveyed for a 10 minute period between the morning hours of 0415 and 1000 hrs, and replicated 7 times each in both 1995 (22 May - 26 June) and 1996 (29 May - 4 July). Surveys were not conducted during periods of rain or heavy wind. See Joy and van den Driessche (1995) and van den Driessche and Joy (1998) for detailed descriptions of these methods.

3.4 Furbearers

During the winters of 1993/1994 and 1995/1996 track surveys for furbearers were conducted in the experimental units and control areas (Corbould and Hengeveld 1998). American marten (*Martes americana*) and fisher (*M. pennanti*) were of primary interest for the study as both species tend to prefer late-seral forests, avoid open areas, and utilize cavities for resting and denning sites (Buskirk and Ruggiero 1994).

In winter 1993/1994, track surveys were conducted in the experimental units and old-growth control areas. Surveys were conducted along transects that ran parallel to one another across the side slope of each sample area (Corbould and Hengeveld 1998). Transects were spaced approximately 150 m apart, resulting in approximately 1.4 km of transect per 25 ha. Track observations were converted into a frequency of tracks/km-day as an index used to rank the different habitats. Each crossing of a transect by an animal was counted as one track; a 1 m buffer on each side of the transect centre-line was used to minimize multiple counting of zigzagging animals. The number of animals using runways were estimated, however, this was not always possible, particularly for snowshoe hare (*Lepus americanus*) and red squirrel (*Tamiasciurus hudsonicus*), so arbitrary estimates of either four (i.e., numerous tracks) or one track (i.e., few tracks) was assigned to each runway. Tracking was done on snowshoe or snowmobile, at least 24 hours after a fresh snowfall, once a month between November and March. Marten tracks were followed on snowshoe and mapped on 1:10,000 scale cutblock maps indicating direction of travel and any important features (e.g., scent markings, subnivean accesses, habitat features, etc.). See Corbould and Hengeveld (1998) for detailed descriptions of methods.

In winter 1995/1996, the same methods for track surveys were used as those used in winter 1993/1994, except for the following differences. Survey transects were added in clearcut control areas. The 1 m buffer along the transect centre-line was extended to 2 m for weasel (*Mustela* spp.) tracks only. A greater effort was put into trailing tracks; up to 4 tracks per area were trailed each survey. Tracks were classified into linear or meandering movements. "Linearity indices" were calculated for each trail segment that occurred across different habitat types (e.g., forest, clearcut, tree island). Hipchains and compasses were used to more accurately document track locations and animal movements. See Corbould and Hengeveld (1998) for detailed descriptions of these methods.

4.0 RESULTS

4.1 Stubs, Tree Islands and Other Habitat Features

In total, 2,133 stubs were created in the 3 experimental cutblocks (Gyug and Corbould 2002). Stubs <15 cm DBH (109 stubs in total) were not included in any analyses. Of the 2,024 stubs ≥15 cm DBH, 1,069 were dispersed stubs and 955 were perimeter stubs fringing tree islands. Decay stage of sapwood and heartwood in stubs was unknown prior to harvest. In 1996 (4-5 years post-logging), a sample of 20% of all stubs ≥15 cm DBH (both dispersed and perimeter stubs) found that 61% had sound sapwood, 36% had spongy sapwood, and 3% had soft sapwood, with no significant differences between tree species. Thirty-eight percent of stubs had sound heartwood, 53% had spongy heartwood, and 9% had soft or very soft heartwood. Lodgepole pine stubs had significantly higher proportions of sound heartwood (54%) compared to spruce or subalpine fir.

The majority (60%) of stubs had >75% bark remaining, 21% had 50-75%, and 19% had <50% bark remaining (Gyug and Corbould 2002). Spruce stubs had significantly more bark (80% had >75% bark remaining) than subalpine fir (54%) and lodgepole pine (44%). Spruce bark appeared to either decay slower or sloughed-off at a slower rate than the other tree species. There was no significant correlation between the amount of bark remaining and sapwood decay for any of the tree species. There was no significant difference between tree species in the amount of their root decay; 24% of stubs had sound lateral roots (no decay), 60% had 75-99% of roots free of decay, and 16% had <75% of roots free of decay.

Retention or survivorship rates for dispersed stubs (between 1992-1996) in experimental Block 5547 was 99% for stubs that were created from live trees and 67-80% for stubs that were already dead or had broken tops prior to or during harvesting (Gyug and Corbould 2002). Retention rates for stems in tree islands varied depending on the amount of blowdown that had occurred between harvest in November 1991 and initial tree tagging in summer 1992, except for perimeter stubs. In 1996 (4.5 years after harvest), a sample of 4 tree islands in Block 5547 found that stem retention rates were 99% for perimeter stubs, 56-76% for live trees, and 42-60% for snags.

Although there were no significant differences in % canopy cover by tree species between tree islands and old-growth controls, overall % canopy cover was lower in tree islands than in old-growth controls (Gyug 1997). This may have been due to the greater amount of blowdown that was present in tree islands compared to the old-growth controls. Tall shrub

(0.5-2.0 m high) % cover was significantly lower in clearcut controls and clearcut areas within experimental units, than in the tree islands and old-growth controls. Reduced shrub cover in clearcuts was a result of most shrubs being knocked over by heavy machinery during clearcutting. There were no significant differences in low shrub (<0.5 m high) % cover across experimental units and controls.

Fireweed (*Epilobium angustifolium*) was absent in old-growth controls and within tree islands, but abundant in clearcut areas (13-25% cover), and was not significantly different among experimental units (Gyug 1997). Moss cover was significantly higher in old-growth controls and tree islands compared to clearcut controls and all clearcut areas of the experimental units. Overall moisture regimes did not differ significantly among experimental units and controls.

4.2 Cavity Nesting Birds

In 1995 and 1996, 34 nest trees containing 47 active cavity nests were found in the study area (Gyug 2002) (Table 1). Nest cavities of 7 bird species were found, only 4 species were considered found commonly in the experimental blocks: Three-toed Woodpecker (*Picoides tridactylus*), Mountain Bluebird (*Sialia currucoides*), Black-backed Woodpecker (*P. arcticus*) and Tree Swallow (*Tachycineta bicolor*). In the experimental units, 19 nest trees containing 31 active cavities of 7 species were found; while in the control areas and surrounding contiguous forest, 15 nest trees containing 16 active cavities of 4 species were found. Of the 19 nest trees in the experimental blocks, 10 trees were used more than once for nesting (within the same year, in consecutive years, or both).

Stubs had a statistically significant positive effect on the number of cavity nests in both 1995 and 1996 (Gyug 2002). Tree islands also had a positive effect on the number of cavity nests, however, due to the small sample size and the large variability between 1995 and 1996, it was not statistically significant. There was no significant difference in the size of tree islands that were selected by cavity nesting birds, however, the small range of tree island sizes was probably not large enough to be of ecological consequence for the various cavity nesting birds.

None of the nests found in stubs were in lodgepole pine, even though approximately 19% of the stubs were pine. Both spruce and subalpine fir were equally selected as nest stubs. Nest stub mean DBH did not differ significantly from the mean DBH of all stubs, however, it did appear that cavity nesting birds selected larger DBH subalpine fir stubs. Only stubs that

were > 27 cm DBH were used for cavity nesting, even though approximately 600 stubs (28.4%) were smaller in size. Only larger stubs were likely to have sufficient heartrot, and therefore available cavity volume suitable for primary cavity excavation; most lodgepole pine stubs were smaller in size and had less heartrot.

Table 1: Summary of cavity nests found in habitat features within experimental units and in control areas at the Donna Creek study area (1995-1996). Number of active nest cavities followed by number of nest trees in parentheses. Data from Gyug (2002).

	Habitat Features		Control Areas		Surrounding Contiguous	
Species*	Stubs (dispersed)	Tree Islands (including perimeter stubs)	Old-growth	Clearcut	Old-growth	Total
Three-toed Woodpecker	1 (1)	4 (3)	0 (0)	0 (0)	11 (11)	16 (15)
Mountain Bluebird	6 (4)	3 (3)	0 (0)	2 (2)	0 (0)	11 (9)
Black-backed Woodpecker	4 (2)	4 (3)	0 (0)	0 (0)	0 (0)	8 (5)
Tree Swallow	4 (2)	2 (2)	0 (0)	1 (1)	0 (0)	7 (5)
Red-breasted Nuthatch	0 (0)	1 (1)	1 (1)	0 (0)	1 (1)	3 (3)
Hairy Woodpecker	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)
Northern Flicker	0 (0)	1 (1)	0 (0)	0 (0)	0 (0)	1 (1)
Total Species	15 (9)	16 (14)	1 (1)	3 (3)	12 (12)	47 (36)
Total Nest Trees	8	11	1	2	12	34

* Bird species in italics are Picoides woodpecker species.

Stub densities within a 50 m radius of nest stubs were not significantly different than randomly selected stubs (Gyug 2002). Of various habitat variables measured around nest stubs, only the following were statistically different compared to habitat plots completed at the nearest songbird point count stations: deciduous shrub cover (< 2 m high) was significantly higher, density of tree stumps ≥20 cm diameter at stump height was significantly higher, and the number of upturned root wads was significantly lower.

All stubs used for cavity nests had heartwood decay classes of very soft or soft (Gyug 2002). *Picoides* woodpeckers excavated nest cavities in stubs with sapwood that was hard to spongy, but not soft. Stub assessments indicated that approximately 7.6% of the 2133 created stubs (162 stubs) had decay characteristics that would be immediately suitable for *Picoides* woodpecker nest cavities. However, habitat requirements and territorial sizes of some *Picoides* species may have limited which stubs were selected. For example, in the study area, Three-toed Woodpeckers tended to nest on the edges of the surrounding contiguous old-growth forest, and only occasionally selected tree islands or stubs for nesting that were close to contiguous forest, and avoided stubs in the open altogether. All Black-backed woodpeckers nests were located in tree islands or stubs, tree islands selected for

nesting did not appear to be close to contiguous forest. All woodpecker species nests were spaced >200 m apart.

Woodpecker feeding sign occurred on approximately half (49.3%) of the sampled stubs (Gyug and Corbould 2002). Subalpine fir stubs had a significantly higher amount of woodpecker feeding sign than other stub species (62%), while lodgepole pine stubs had significantly lower sign (13%), and spruce had 49%. Most of the feeding on stubs was probably from Black-backed Woodpecker as behavioral studies found that they spent 89% of their time on stubs, while Three-toed Woodpeckers spent 0% of their time on stubs, 68% in tree islands, and 32% in contiguous forests. There were insufficient observations and nests of Hairy Woodpecker (*P. villosus*) and Northern Flicker (*Colaptes auratus*) to draw any conclusions of their use of stubs or tree islands.

4.3 Songbirds

During 1995 and 1996, 54 species of territorial birds (singing males) were detected during songbird point counts; an additional 16 species were recorded through other sampling methods or were thought to be non-territorial (Gyug 1997). In the experimental units, 41 territorial bird species were detected during point counts, while 37 species were detected in old-growth controls and 17 species in clearcut controls.

In general, stubs and tree islands increased the diversity of bird species detected compared to clearcuts due to the additional habitat elements that stubs and tree islands provided. Stub-only treatments had a significant positive effect on the mean density of only Yellow-rumped Warblers (*Dendroica coronata*) (Gyug 1997). Tree islands had positive effects on the densities of Swainson's Thrush (*Catharus ustulatus*) and Yellow-rumped Warbler, and on the total number of all birds detected (i.e., all singing bird detections combined). Total bird densities (i.e., combined singing males and other detections) were significantly lower in all experimental treatment units compared to old-growth forest controls. However, densities of all birds and singing males were significantly higher in tree islands than in clearcut areas and clearcut controls. No bird species exhibited significant differences in mean densities between the clearcut treatments and clearcut controls. Fourteen species were significantly more abundant in old-growth controls than in all treatments, including 5 cavity nesting bird species (see Table 2 for summary).

On average, stubs increased species richness by 2.2 species (16%) compared to traditional clearcuts, however, this trend was not statistically significant (Gyug 1997). Tree islands

increased species richness significantly by 8.9 species (66%) compared to traditional clearcuts. However, clearcuts with tree islands still had an average of 4.5 fewer species than old-growth controls.

Table 2: Statistical differences between densities of 21 bird species found in experimental units and control areas in the Donna Creek study area (1995-1996).

Bird Species*	Significant Difference in Densities
Blackpoll Warbler	• Old-growth control > all experimental units and clearcut control
Boreal Chickadee	• Old-growth control > all experimental units and clearcut control
Brown Creeper	• Old-growth control > all experimental units and clearcut control
Golden-crowned Kinglet	• Old-growth control > all experimental units and clearcut control
Gray Jay	• Old-growth control > all experimental units and clearcut control
Northern Waterthrush	• Old-growth control > all experimental units and clearcut control
Red-breasted Nuthatch	• Old-growth control > all experimental units and clearcut control
Ruby-crowned Kinglet	• Old-growth control > all experimental units and clearcut control
Spruce Grouse	• Old-growth control > all experimental units and clearcut control
Three-toed Woodpecker	• Old-growth control > all experimental units and clearcut control
Townsend's Warbler	• Old-growth control > all experimental units and clearcut control
Winter Wren	• Old-growth control > all experimental units and clearcut control
Swainson's Thrush	• Old-growth control > all experimental units and clearcut control; • Tree islands > all other experimental units
Evening Grosbeak	• Old-growth control > clearcut control
Yellow-rumped Warbler	• Old-growth control > clearcut control; • Stubs and tree islands > all other experimental units; • Tree islands > old-growth and clearcut controls
Wilson's Warbler	• Old-growth control > clearcut experimental units; • Tree islands > old-growth and clearcut controls
American Robin	• Tree islands > old-growth and clearcut controls
Black-backed Woodpecker	• Tree islands > old-growth and clearcut controls
Chipping Sparrow	• Tree islands > old-growth and clearcut controls; • Stubs-and-islands > old-growth control
Savannah Sparrow	• Clearcut controls > tree island and old-growth controls
Lincoln's Sparrow	• Clearcut controls > tree island and old-growth controls; • Most experimental units > old-growth control

* Italicized bird species were categorized as cavity nesting birds for the study.

4.4 Furbearers

In 1993/1994, 107.7 km-days were surveyed, resulting in 137 squirrel tracks, 115 weasel (*Mustela spp.*), 73 snowshoe hare, 61 marten, 18 wolf (*Canis lupus*), 4 coyote (*C. latrans*), 3 lynx (*Lynx canadensis*), 2 vole (*Microtus* spp.), and 1 fox (*Vulpes vulpes*) (Corbould and Hengeveld 1998). Old-growth controls had the highest indices of marten use (2.86 tracks/km-day), but they were not significantly greater than tracks/km-day found in the experimental units. The 18 wolf tracks were from a pack of three wolves that passed through one of the experimental cutblocks. The coyote, lynx and fox tracks were thought to be from single animals.

In 1993/1994, 4 marten tracks were trailed for approximately 1.5 km (Corbould and Hengeveld 1998). All tracks entered at least one tree island; 4 subnivean access points were observed (3 inside tree islands and 1 in a stub area). Although tree islands appeared to be used for marten foraging, stubs did not appear to influence marten movements, as none were visited by trailed animals.

In 1995/1996, due to the lack of suitable snow conditions for tracking, survey effort was switched from transect surveys to track trailing (Corbould and Hengeveld 1998). Snow conditions only permitted track transects to be conducted on two days, resulting in seven squirrel tracks in old-growth controls, and four weasel tracks (two in stub-and-island experimental units and two in clearcut experimental units). No tracks/km-day indices were calculated due to insufficient sample sizes.

In 1995/1996, equal tracking effort was given to all areas. Surveys found 25 marten and one fisher track in old-growth controls, suggesting that foraging (e.g., accessing subnivean sites) and scent marking behavior were more prevalent in old-growth controls than in experimental units and clearcut controls (Corbould and Hengeveld 1998). However, such behaviors were not significantly different across the habitat/treatment types. Four of five track trails that entered experimental units visited at least one tree island, suggesting that tree islands were influencing animal movement patterns. However, data was insufficient to determine if tree islands and/or stubs provided any significant benefit to marten or fisher, only that they were visited. During both survey winters, no marten or fisher tracks were observed in clearcut controls, and only one set of marten tracks was found in a clearcut experimental unit.

Dens, or potential dens, probably from red squirrel, were found in three stubs from the 20% sample of decay-assessed stubs in stub-and-island and stub experimental units (Gyug and Corbould 2002 All were found at the base of subalpine fir stubs with DBHs of 31, 35 and 59 cm. It was likely that more den cavities were missed during assessments, as searching for den cavities was not the focus of these assessments. Ten other burrows/dens were found incidentally at the base of stubs, half in spruce and half in subalpine fir. Mean DBH of these stubs was 43.1 cm (n=6, SE = 3.3 cm; range = 30-65 cm DBH).

5.0 SUMMARY

5.1 Stubs, Tree Islands and Other Habitat Features

- 2,133 stubs were created in the 3 experimental cutblocks; 2,024 of which were ≥15 cm DBH; 52.8% of the ≥15 cm DBH stubs were dispersed stubs and 47.2% were perimeter stubs fringing tree islands;
- retention rates (4.5 years post-harvest) for a sample of dispersed stubs was 99% for stubs created from live trees and 67-80% for stubs that were dead or had broken tops prior to or during harvesting; and
- retention rates (4.5 years post-harvest) for a sample of 4 tree islands had stem retention rates of 99% for perimeter stubs; 56-76% for live trees and 42-60% for snags.

5.2 Cavity Nesting Birds

- 34 nest trees containing 47 active cavity nests were found in the study area;
- nest cavities were of 7 different bird species;
- spruce and subalpine fir were equally selected as cavity nesting stubs;
- none of the cavity nests were found in lodgepole pine stubs;
- only stubs that were > 27 cm DBH were used for cavity nesting;
- all cavity nesting stubs had heartwood decay classes of very soft or soft;
- woodpecker feeding sign occurred on half (49.3%) of all sampled stubs; and
- subalpine fir stubs were used most frequently for feeding (62% of all stubs), followed by spruce (49%) and lodgepole pine (13%).

5.3 Songbirds

- 54 territorial bird species were detected during songbird point counts;
- 16 additional species were recorded through other sampling methods or were thought to be non-territorial;
- 41 territorial bird species were detected in the experimental units during point counts, 37 species in old-growth controls, and 17 species in clearcut controls;
- densities of all bird detections were significantly lower in all experimental treatment units compared to old-growth forest controls;
- compared to traditional clearcuts, stubs increased species richness by 2.2 species (16%), and tree islands increased species richness by 8.9 species (66%); and
- clearcuts with tree islands had an average of 4.5 fewer species than old-growth controls.

5.4 Furbearers

- old-growth controls had the highest indices of marten use, but were not significantly greater than experimental units; and
- tree islands appeared to influence animal movement patterns and were used by marten.

6.0 CONCLUSIONS

6.1 Stubs, Tree Islands and Other Habitat Features

Stem retention and descriptive data for stubs and tree islands collected to date provide a baseline dataset that can be used for future monitoring of these features. Gyug and Corbould (2002) provided insight into some of the long-term comparisons that can be made:

- retention or survivorship (i.e., fallover) rates of all "tagged" stubs by species and DBH;
- retention or survivorship rates of trees, snags and perimeter stubs associated with the 4 tree islands in Block 5547;
- decay and retention or survivorship rates of stubs in the 1996 20% stub sub-sample, by tree species, decay class and DBH;
- number of newly excavated cavity nests in the entire stub population since 1996, and correlate this with tree species, DBH and location; and
- number of newly excavated cavity nests and woodpecker feeding sign in the 20% stub sub-sample, and correlate this with stub decay class (wood condition), species, DBH and location.

6.2 Cavity Nesting Birds

The short-term effects of clearcutting old-growth forests differ significantly from the effects of wildfire disturbance on habitat for cavity nesting species (Schieck and Hobson 2000). Typically, there are large numbers of standing dead trees after wildfires, providing good quality foraging and nesting habitat for many species of cavity nesting birds. This is not the case after conventional clearcutting, where little or no vertical structure remains on site. Results from the Donna Creek study suggest that the retention of stubs and tree islands can mitigate the negative habitat effects associated with clearcutting (i.e., loss of forest structure) for some bird species (Gyug 2002).

Stub densities of 5-10 stubs/ha in combination with tree islands of approximately 0.25 ha in size may provide a good method for mitigating habitat loss associated with clearcutting for Black-backed Woodpecker (Gyug 2002). However, these measures are probably inadequate for Three-toed Woodpecker, but may be of some use if stubs and tree islands are located within 50 m of contiguous forest. Higher stub densities appeared to provide better habitat for Black-backed Woodpecker than lower densities (Gyug 1997).

For secondary cavity users, such as Tree Swallow, Mountain Bluebird and American Kestrel (*Falco sparverius*), stubs and/or tree islands may be good methods for mitigating habitat loss (Gyug 2002). Stubs, particularly in higher densities, appeared to be important for Tree Swallow and Mountain Bluebird, while tree islands, even with large numbers of perimeter stubs, were used very little by bluebirds (Gyug 1997, 2002). During the short term (1-4 years post-harvesting), stubs and/or tree islands did not appear to provide sufficient habitat for Boreal Chickadee (*Poecile hudsonicus*), Red-breasted Nuthatch (*Sitta canadensis*), Brown Creeper (*Certhia americana*) or Winter Wren (*Troglodytes troglodytes*); these species tend to require nest trees with softer sapwood and greater surrounding vertical structure (Gyug 2002).

In general, to maximize the benefits of stubs for cavity nesting birds, stubs should be as large as possible, and preferably > 27 cm DBH. Spruce and subalpine fir should be selected as stubs over lodgepole pine. Stubs left for foraging habitat can be any size, but larger spruce and subalpine fir are again preferable (Gyug 2002).

6.3 Songbirds

The small sizes of tree islands (0.18-0.40 ha) used in the Donna Creek study are generally not large enough to provide adequate breeding habitat for most forest songbird species, as many require much larger forested areas (Gyug 1997). Although tree islands significantly increased the mean density of all bird species, they only increased the density of specific species such as American Robin (*Turdus migratorius*), Chipping Sparrow (*Spizella passerina*) and Swainson's Thrush that do not require larger forested areas for breeding. Many of the bird species that were detected in the tree islands may not have nested within them, but may have only included the tree island as part of their breeding territory and nested elsewhere. Consequently, tree islands should at least be larger than 0.4 ha to provide habitat conditions suitable for a greater variety of forest bird species.

Experimental stubs, both dispersed and those located around the perimeter of tree islands, were used for nesting, as foraging perches, singing perches, and as foraging substrate. However, the net benefits of stub creation, with only a few songbird species showing a statistically significant positive effect, were subtle compared to the much greater effect of tree islands (Gyug 1997). In 1993, significant stub effects were found only for Tree Swallows, woodpeckers (as a group) and for Olive-sided Flycatchers (*Contopus cooperi*) (Gyug and Summers 1995). The effects on Tree Swallows were also significant in 1995, but

not for combined data for 1995 and 1996 (Gyug 1997). In general, woodpeckers made more use of tree islands than stubs where both were available. However, where there are no tree islands, stubs, particularly at higher densities, will be used by woodpeckers (especially by Black-backed Woodpecker).

Data from other studies in southern BC suggest that tree islands that are ≥2 ha provide habitat for a far larger number of forest bird species than smaller tree islands (Gyug and Bennett 1996). As a result, larger tree islands (≥2 ha) and higher densities of stubs (>15 stubs/ha) appear to provide greater habitat benefits to a greater number of bird species than smaller tree islands and lower stub densities (Gyug 1997).

6.4 Furbearers

Results obtained from the furbearer track surveys are inconclusive for determining any habitat preferences between experimental units and control areas. The small sample size of individuals found in the study area does not provide an accurate baseline for future comparisons on stub and tree island effects on these wildlife species. In addition, the large territorial sizes of most furbearers, particularly marten (1-4 km^2 home ranges; Buskirk and Ruggiero 1994, and fisher (>15 km^2 home ranges; Powell and Zielinski 1994), makes the current study design inappropriate for determining furbearer habitat use at the stand level (Corbould and Hengeveld 1998). As a result, data collected in the Donna Creek study on marten and fisher are more than likely associated with only a few individuals, and are probably not representative of a population or general species trends.

REFERENCES

Note: *This report is a summary of the boldface references shown below.*

Backhouse, F. 1993. Wildlife tree management in British Columbia. Co-published by Worker's Compensation Board, B.C. Silviculture Branch and Canada-B.C. Partnership Agreement on Forest Resource Development: FRDA II.

Buskirk, S.W., and L.F. Ruggiero. 1994. American marten. Pp. 7-37 in: L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski (tech. eds.). The scientific basis for conserving forest carnivores: American, fisher, lynx and wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: US Department of Agriculture, Rocky Mountain Forest and Range Experiment Station.

Corbould, F.B. and P.E. Hengeveld. 1998. Donna Creek winter furbearer surveys. Peace/Williston Fish and Wildlife Compensation Program Report No. 179. 20 pp. plus appendices.

Dawson, R., L.J. Murray and M.D. Wood. 1992. Wildlife tree maintenance and creation in managed ESSF forests in the Mackenzie district. Peace/Williston Fish and Wildlife Compensation Program Report No. 16. 13 pp. plus appendices.

Demarchi, D. 1995. Ecoregions of British Columbia. 3rd Edition. BC Ministry of Environment, Lands and Parks, Victoria, BC. Map.

Gyug, L.W. 1996. Donna Creek Forestry/Biodiversity Project: Breeding bird point counts 1995. Peace/Williston Fish and Wildlife Compensation Program Report No. 53. 30 pp. plus appendices.

Gyug, L.W. 1997. Donna Creek Forestry/Biodiversity Project: Breeding bird point counts 1995 and 1996. Peace/Williston Fish and Wildlife Compensation Program Report No. 129. 40 pp. plus appendices.

Gyug, L.W. 2002. Donna Creek Forestry/Biodiversity Project: Cavity nests 1995-1996. Peace/Williston Fish and Wildlife Compensation Program Report No. 253. 52 pp. plus appendices.

Gyug, L.W. and S.N. Bennett. 1996. Bird use of wildlife tree patches 25 years after clearcutting. Pp. 15-34 in: Bradford, P., E.T. Manning and W. l'Anson (eds.). Wildlife Tree/Stand-level Biodiversity Workshop Proceedings (1995), Victoria, BC. Co-published by BC Ministry of Forests and BC Environment, Victoria, BC.

Gyug, L.W. and F.B. Corbould. 2002. Donna Creek Forestry/Biodiversity Project: Stubs, residual islands and other habitat characteristics. Peace/Williston Fish and Wildlife Compensation Program Report No. 252. 58 pp. plus appendices.

Gyug, L.W. and K. Summers. 1995. Donna Creek biodiversity project: Preliminary breeding bird surveys 1993. Peace/Williston Fish and Wildlife Compensation Program Report No. 41. 45 pp. plus appendices.

Joy, J. and R. van den Driessche. 1995. Donna Creek biodiversity project: Spring 1995 breeding bird surveys, summary report. Peace/Williston Fish and Wildlife Compensation Program Report No. 44. 4 pp. plus appendices.

Joy, J. and R. van den Driessche. 1998. Donna Creek Forestry/Biodiversity Project: Habitat use of cavity nesting birds in the Donna Creek study area, 1995. Peace/Williston Fish and Wildlife Compensation Program Report No. 54. 26 pp. plus appendices.

MacKinnon, A., C. Delong and D. Meidinger. 1990. A field guide for identification and interpretation of ecosystems of the northwest portion of Prince George Forest Region. Land Management Handbook No. 21. BC Ministry of Forests, Victoria, BC. 116 pp.

Murray, L.J. 1992. Cavity nester habitat selection project, phase 1 report: Snag deterioration. Peace/Williston Fish and Wildlife Compensation Program Report No. 13. 11 pp.

Murray, L.J. 1992. Cavity nester habitat selection project, phase 3 report: Map preparation and transect layout. Peace/Williston Fish and Wildlife Compensation Program Report No. 20. 11 pp. plus appendices.

Powell, R.A. and W.J. Zielinski. 1994. Fisher. Pp. 38-73 in: L.F. Ruggiero, K.B. Aubry, S.W. Buskirk, L.J. Lyon, and W.J. Zielinski (tech. eds.). The scientific basis for conserving forest carnivores: American, fisher, lynx and wolverine in the Western United States. Gen. Tech. Rep. RM-254. Ft. Collins, CO: US Department of Agriculture, Rocky Mountain Forest and Range Experiment Station.

Schieck, J. and K.A. Hobson. 2000. Bird communities associated with live residual tree patches within cut blocks and burned habitat in mixedwood boreal forests. Canadian Journal of Forest Research 30:1281-1295.

van den Driessche, R. and J. Joy. 1998. Methods of 1996 breeding bird investigations: Point count surveys, cavity nest searches, and cavity nest habitat characterization. Peace/Williston Fish and Wildlife Compensation Program Report No. 247. 12 pp. plus appendices.

Wood, M.D. 1992. Donna Creek biodiversity project (cavity nester habitat selection): Progress report 1992/93. Peace/Williston Fish and Wildlife Compensation Program Report No. 19. 8 pp. plus appendices.

Wood, M.D. 1994. Donna Creek biodiversity project: Progress report 1993/94 and 1994/95. Peace/Williston Fish and Wildlife Compensation Program Report No. 37. 7 pp.

Wood, M.D. 1995. Donna Creek biodiversity project: Progress report 1995/96. Peace/Williston Fish and Wildlife Compensation Program Report No. 46. 7 pp.